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Indian Standard
CODE OF PRACTICE FOR
CONTROL OF AFLATOXIN IN GROUNDNUT

PART I HARVESTING, TRANSPORT AND STORAGE
OF GROUNDNUTS

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CONTROL OF AFLATOXIN IN GROUNDNUTPART I HARVESTING, TRANSPORT AND STORAGE
OF GROUNDNUTS

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Indian Standard
**CODE OF PRACTICE FOR
CONTROL OF AFLATOXIN IN GROUNDNUT
PART I HARVESTING, TRANSPORT AND STORAGE
OF GROUNDNUTS**

0. FOREWORD

0.1 This Indian Standard (Part I) was adopted by the Indian Standards Institution on 26 February 1979, after the draft finalized by the Nutrition Sectional Committee had been approved by the Agricultural and Food Products Division Council.

0.2 Groundnuts constitute half of India's total oilseed crops. Groundnuts are consumed as such, sometimes raw but generally after roasting, or are used in the preparation of various Indian dishes. A large portion of the crop is crushed for oil in village ghanis or in expeller presses, and the oilcake thus generated is further solvent extracted of its residual oil. Both expeller-pressed and solvent-extracted oilcakes are exported on an enormous scale for use in animal feeds.

0.3 The discovery around 1960 that the common mould *Aspergillus flavus* could grow on groundnuts and groundnut cakes to elaborate highly toxic materials, the aflatoxins, led to a surge of interest in these compounds and in the other mycotoxins found in many common foodstuffs. These toxins are involved in cell multiplication and therefore, are particularly harmful for the young of any species, which are in a stage of rapid growth. Aflatoxins have been implicated in liver cirrhosis, and are probably also carcinogenic. When fed to milch animals, they enter the milk in a modified form, which is likewise highly toxic. Not only for use as human food, therefore, but also for animal feeds, many countries have laid down permissible limits for aflatoxins. Rejection of lots with high aflatoxin levels will mean financial loss.

0.4 There is therefore, both a nutritional and an economic need for keeping the levels of aflatoxin as low as possible. It is now well established that the causative moulds are very common and are present everywhere, and particularly in the soil. Groundnuts develop under earth, and this favours such mould growth. High moisture levels in the nuts are necessary for mould multiplication, therefore groundnuts which are dried to low levels of moisture will not favour mould multiplication.

Any crack or split in the pods, when either the whole plants with the nuts attached, or the detached green nuts themselves, are dried in the field will permit penetration of the mould. Thus too slow drying will prolong the danger period, whereas too rapid drying can also lead to cracking of nuts. Contact with wet earth, or the occurrence of rains during the harvesting or drying period (as is common in coastal Andhra Pradesh, Tamil Nadu and Saurashtra) are conducive to mould attack. Contaminated nuts spread infection to sound ones. Further, improperly-dried groundnuts will yield oil which carries a high free acidity, and a correlation between aflatoxin content and free fatty acids level in the oil has been noted.

0.5 Moulds can be minimized through general cleanliness, and destroyed by using appropriate fumigants. Fumigation can even be done in the fields and is especially called for when the drying period of the nuts is likely to be prolonged due to rainy weather. Preventive fumigation is also useful during long storage of nuts in bins or silos. However, the mould is not destroyed by fumigation and adequate drying subsequently is still necessary.

0.6 This code has been developed to outline practical measures which farmers can employ to prevent aflatoxin development in groundnut kernels during harvesting, transport and storage. IS : 5686-1970* gives detailed directives for sound procedures applicable to oilseeds in general. All these directives are highly relevant to groundnuts and their adoption requires to be re-emphasized at this point. The present code of practice attempts to avoid repetition of the earlier code, and to pay more specific attention to the prevention of mould growth in groundnuts.

0.7 A separate standard is also being issued simultaneously as IS : 9071 (Part II)-1979†, which is complementary to this standard and meant for the use of processors of groundnuts, and users of raw groundnut oil.

0.8 In the preparation of this standard considerable assistance has been derived from The Oil Technological Research Institute, Anantapur and The Protein Foods & Nutrition Development Association of India, Bombay.

0.9 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960‡. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Code of practice for handling and storage of oilseeds.

†Code of practice for control of aflatoxin in groundnut : Part II Plant storage and processing flour and oil.

‡Rules for rounding off numerical values (revised).

1. SCOPE

1.1 This standard (Part I) recommends methods for harvesting, transport and storage of groundnuts for minimizing the development of aflatoxin through the growth of the causative moulds.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Haulms — Green uprooted groundnut plants with nuts attached.

2.2 Bags — Jute bags with oilseeds, weighing approximately 90 kg.

2.3 Mandi — Market warehouse.

2.4 Pucca Room — Room with sound flooring, roof and walls.

3. HARVESTING AND DRYING

3.1 Harvesting — Groundnuts shall be harvested when they are mature or nearly so. Immature nuts should not be harvested since they dry more slowly and are more susceptible to mould attack. Groundnuts should also not be left in the ground after attaining maturity. To determine nut maturity, a few plants should be pulled out after the leaves turn yellow and, the inside surface of the nuts examined. If a quarter at least of the pods show a brown inside surface and darkened veins, and if the kernels show a mature colour, it is time to harvest them. Shells should not be broken or damaged mechanically during harvesting. Diseased plants should, on uprooting, be separated from sound plants and put to dry in separate lots. The use of varieties which mature after the end of the rainy season may be encouraged.

3.2 Curing — This is a crucial step, when the moisture in the kernels should be reduced from about 35 percent to less than 7 percent. A dry place should be used for the operation. In order to keep the haulms off the ground, they should be spread out on racks to permit drying by the wind, or tied in bundles along an upright pole with their roots outwards. If there is no alternative to spreading the plants on the ground, a mat of some kind should be used, and a cover should be provided against direct rain or exposure to very hot sun. Groundnuts thus spreadout should not be trampled upon. To judge the safe final moisture level the pod is held between the thumb and forefinger, and shaken. A crackling noise will be heard if the pod is dry enough. The kernel when dry will also have a nutty flavour on munching.

3.2.1 In areas where the groundnut harvesting and drying season coincides with rainy weather, these precautions need special emphasis. Artificial drying with a current of warm air, in suitable ways, is desirable, care being taken to ensure a slow loss of moisture and thus prevent pod splitting. Use of reliable moisture meters to measure the moisture level can also be strongly recommended.

3.2.2 Where artificial drying cannot be employed, and the heap of plants is drying very slowly because of humid weather, mould growth is almost sure to occur. In such cases, the heap should be covered with a high density polyethylene sheet and a fumigant mixture of methyl bromide and ethylene dibromide (48 mg/kg of seeds) allowed to pass under this cover. Air-drying of the heap should be resumed as soon as possible. Ammonia and phosphine can also be generated *in situ* for controlling fungal growth using ammonium sulphate and lime as a premix with a phosphine tablet. The concentration of ammonia should be higher than phosphine during fumigation, the best proportion being 1.5 : 1. This fumigation can be carried out under low density polyethylene.

3.3 Drying — After the pods have been detached from the plants, the removal of further moisture to a final level of less than 7 percent, which generally takes about a week, constitutes the drying operation. Many of the precautions outlined earlier (*see 3.2*) are still necessary, especially the avoiding of contact with moisture.

3.3.1 If the pods are spread out on the ground to dry, a floor, platform, mat or plastic sheet should always be used.

3.3.2 Use of trays (chandrikas) with an open-weave base, which are kept on a raised rack, will permit free flow of air and assist drying.

3.3.3 Groundnut pods may also be placed in coarse gunny bags which are then freely suspended on frames and protected from rain by a cover of galvanized iron. In such swinging bags, free air movement will facilitate drying. The nuts can also be taken off the haulms after harvest and rapidly dried in thin layer.

3.4 Pre-sale Storage — Loose kernels or bags should on no account be kept on the bare ground, and a cover for protection from rain should be provided. Use of a pucca room for storage at the farm will minimise loss and prevent spoilage due to rodents and insects.

4. TRANSPORT

4.1 Groundnuts are moved from the point of production to the point of storage either in bulk or in bags, usually made of gunny cloth, employing trucks, or carts as carriers. In this process, dampness, lack of hygiene and mechanical damage should be avoided.

4.2 Carriers should be clean and dry, and covered in such a manner as to shield the nuts from rain, flying slush, birds and other contamination. Carriers should be swept, washed and dried as frequently as possible to avoid carry-over contamination.

4.3 During loading and unloading, care should be taken to ensure that the bags do not get wet. Tearing or damage of the bags through hooks or nails should be avoided. Violent handling or throwing, resulting in impact of the bags or of the loose nuts against a hard surface will cause mechanical injury and open the way to mould infection.

5. STORAGE IN WAREHOUSES OR MANDIS

5.1 Cleaning of Warehouse — Two or three weeks before the nuts are expected for storage, and at periodic intervals, the warehouse and its surroundings should be thoroughly cleaned. The walls, window sills, ledges, rafters, beams and other parts of the building should be thoroughly swept down. Trash, spillage of old nuts, grain or animal feed remaining from previous use, both in and around the warehouse or mandi, should be cleaned out. Since this material is rich in live insects, eggs and moulds, it should be burnt, buried or removed far away.

5.2 Spraying of Warehouse — After the warehouse has been cleaned and has dried, and about two weeks before the nuts come in, the floors, walls, beams and ceiling of the interior or the empty warehouse or mandi should be sprayed with a residual insecticide, such as 0.3 percent lindane or 3 percent malathion, in the form of an emulsion spray at the rate of 3 litres per 100 m². After this, the outside walls of the building should be sprayed to the roof, or if too high, at least to a height of about 2 metres. Wherever possible, the ground should also be sprayed to a distance of about 2 metres around the warehouse or mandi. For outdoor treatment 5 percent DDT as wettable powder, may be used, while for indoor treatment lindane or malathion formulations are preferable.

5.3 Bagging of Groundnuts — Storage of groundnuts in pods should be preferred to storage of shelled nuts; this provides much greater resistance to mould growth, insect infestation and rodent attack, and pods can be decorticated when needed. The empty bags used for filling the pods or nuts should be rendered insect-free by appropriate fumigation treatment, such as fumigation with methyl bromide, carried out in an air-tight enclosure or chamber. The bags after filling with pods or nuts must be suitably stitched or sealed to prevent spillage.

5.4 Stacking of Bags — In stacking the bags in the warehouse or mandi, at least a 1-metre corridor should be left for free movement of workmen, inspectors and spraying equipment and personnel. Stacks should preferably be kept raised from the ground on strip-wooden platforms (pallets). These stacks should not be more than 10 metres square

and 3 metres high; it is advantageous to build the stacks around and internal open chimney which will provide for free upwards movement of currents of hot air, drawing in cold air by natural convection and thus promoting cooling.

5.5 Fumigation — Soon after stacking, it is desirable to fumigate the stacks to free them of resident infestation by enclosing the stacks in gas-proof tarpaulins or other stout plastics and exposing them to fumigants such as methyl bromide (32 g/m³) for 24 hours. During subsequent storage, spraying of the stacks once every 3 months to prevent cross-infestation is desirable, using lindane, malathion or pyrethrum spray formulations.

5.6 Checking and Inspection — Continuous checking during storage can forestall problems. The relative humidity level in the warehouse should be 75 percent or below if the nuts, on attaining equilibrium moisture level, are to be below the safe limit. Paper strips dried after dipping in 0.1 percent aqueous cobalt thiocyanate solution, if placed in the stack, will remain blue below 70 percent relative humidity, and gradually turn pink above it, signalling that the groundnuts are at risk of mould infection. Hot spots of locally-overheated nuts should be watched for, and the seeds cooled with a fan applied locally, or disposed off at once. Using tube sampling devices, nuts should be withdrawn at random every week and inspected for caking caused by fungus, or for brown spots of discolouration on the inner white surfaces of split nuts caused by mould. Such seeds should then be removed to prevent cross-infestation and treated separately.

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INDIAN STANDARDS

ON

NUTRITION

IS:

- 3137-1974 High protein mixes for use as food supplement (*first revision*)
- 4684-1975 Edible groundnut flour (expeller pressed) (*first revision*)
- 4874-1968 Cottonseed flour (expeller pressed) (*first revision*)
- 4875-1975 Edible groundnut flour (solvent extracted) (*first revision*)
- 4876-1968 Cottonseed flour (solvent extracted) (*first revision*)
- 6108-1971 Edible sesame flour (solvent extracted)
- 6109-1971 Edible sesame flour (expeller pressed)
- 7021-1973 Protein rich food supplements for infants and preschool children
- 7481-1974 Method for determination of protein efficiency ratio (PER)
- 7482-1974 Protein-based beverages
- 7487-1974 Protein rich biscuits
- 7835-1975 Edible low-fat soya flour
- 7836-1975 Edible medium-fat soya flour
- 7837-1975 Edible full-fat soya flour
- 8211-1976 Edible soya protein isolate
- 8212-1976 Edible groundnut protein isolate
- 8220-1976 Protein rich concentrated nutrient supplementary foods
- 8222-1976 Edible leaf protein concentrate
- 8664-1977 Edible coconut flour (expeller pressed)
- 8665-1977 Protein fortified bread
- 8676-1977 Edible coconut flour (solvent extracted)
- 8677-1977 Edible sunflower flour (solvent extracted)
- 8678-1977 Vegetable protein-based yoghurt (vegetable curds)